THE UNIVERSITY OF ALBERTA

A STUDY OF THE HANDWRITING PERFORMANCE IN RANDOMLY SELECTED AND PHYSICALLY AWKWARD SAMPLES OF CHILDREN.

BY

BARBARA J. CERILLI

A THESIS

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DEPARTMENT OF PHYSICAL EDUCATION AND SPORT STUDIES

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This above all: to thine own self be true.

- Shakespeare, *Hamlet*

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For Calvin and Clair
The sunshine of my life.

ABSTRACT

The Knowledge-Based Approach to Motor Skill Acquisition by Wall, McClements, Bouffard, Findlay and Taylor (1985) is utilized in this study to examine the handwriting performance for physically awkward and randomly selected children in grades four, five and six.

A Handwriting Performance Rating Checklist (H.P.R.C.) was developed to screen students suspected of having handwriting difficulties.

Part one of the study examined the incidence of handwriting difficulties in a sample of grade four, five and six students. The relationship of subject gender and a grade level difference in teacher responses was also examined. The results indicated that the incidence of handwriting difficulties as identified through the H.P.R.C. was approximately 30% of the sample. The implications of illegible handwriting to the student may be serious. A significant proportion of male students comprised the group about whom the teachers indicated a concern for handwriting performance. A grade level difference in teachers responses across the grades was not found.

Part two established the interobserver reliability of the Handwriting Performance Rating Checklist (H.P.R.C.). The percentage of agreement between teachers for each question of the checklist was 76.3% agreement.

Part three examined the persistence of handwriting problems from one grade to the next. A high agreement rate (87.5%) between the two teachers on the initial question of the H.P.R.C. suggest that handwriting performance is a stable characteristic of the student from one year to the next.

Part four of the study investigated the incidence of handwriting difficulties in physically awkward subjects and compared this to a randomly selected sample. Fifty-five percent of the responses indicated a concern for the handwriting skills of the subjects in the physically awkward group as compared to 30% in the randomly selected sample. These results may indicate that gross motor awkwardness may increase the risk of experiencing fine motor (handwriting) awkwardness. However the incidence of concern for handwriting performance in physically awkward subjects is not high enough to suggest that awkwardness is a general characteristic that crosses domains.

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CHAPTER ONE

INTRODUCTION

Movement is a vital part of the normal development for all children. Through a wide variety of movement experiences, especially through natural play opportunities, children explore and learn about their environment (McMath, 1980). The physical, social, emotional and intellectual growth of children is influenced by structured and unstructured movement experiences. Successful movement experiences provide children with an increase in self-image and self-confidence (Roberts, Kleiber & Duda, 1981; Roberts, 1984). Good positive feelings give children the confidence and desire to attempt greater challenges. A broader skill repertoire and increased movement competence may result. Other benefits of successful movement experiences are a greater acceptance by peers (Taylor, 1984; Gordon & McKinlay, 1980) and lifelong physical fitness and good health attained through participation in activity (Pyfer, 1988).

There is evidence that motor learning difficulties may give rise to problems in a child's behavioral, emotional and cognitive development (Taylor, 1984; Silva, McGee & Williams 1982; McMath, 1980; Gordon & McKinlay, 1980). Research suggests that there may exist a relationship between motor skills and cognitive development whereby poor fine and gross motor skills increase the risk of academic difficulties in areas such as reading, mathematics and handwriting (Briggs, 1970; Groff, 1984; Taylor, 1982). Research findings indicate that the incidence of individuals with poor motor skills is significant and its consequences are

serious enough to warrant attention. It is estimated that teachers will have two children in their classrooms with movement difficulties serious enough to require a remedial program (Gordon & McKinlay, 1980; Henderson & Hall, 1982). Wall and Taylor (1983) indicate that closer to 9% of children in each class may experience movement difficulties. Other estimates are as high as 15% of the normal school population (Cratty, 1975).

This study will examine the relationship between fine motor and gross motor awkwardness in the handwriting performance of randomly selected and physically awkward samples of children. The Knowledge-Based Approach to Motor Skill Acquisition by Wall, McClements Bouffard, Findlay and Taylor (1985) is the theoretical background for this study and will be described in the following pages.

Definition of Physical Awkwardness

The description and identification of children experiencing moderate to severe motor problems are found in research literature dating back to the 1920's when Oseretzsky focused on devising a test to identify a group of children he termed "motor idiots". Other common terms used through the years have been "clumsy" (Gordon & McKinlay, 1980; Keogh, 1977; Gubbay, 1975), "physically awkward" (Wall et al., 1985), and more recently, "physically challenged "(Gallahue, 1987). For the purposes of this study, children experiencing difficulties with their motor skills will be referred to as "physically awkward."

Wall describes physically awkward children as "children without known neuromuscular problems who fail to perform culturally-normative motor skills with acceptable proficiency "(Wall, 1982, p.254). Culturally

normative skills are those that are "generally used within a specific culture at certain ages by the majority of the people" (Wall, 1982, p. 254). A culturally-normative skill to Canadian youth may be hockey or ringette whereas to Australian youth it may be soccer or rugby. Wall describes proficiency as characterized by "purposeful, accurate and precise movement". Wall states that acceptable proficiency is dictated by age, sex, socio-cultural environment and performance expectations of parents, teachers and peers.

The characteristics describing proficiency are often lacking in the performances of physically awkward children. For example, awkward children may fumble a ball in an attempt to retrieve it after an unsuccessful catch, whereas non awkward children would complete the catch. The awkwardness will frequently become more obvious as the demands of the task shift from response loaded tasks to complex perceptual or cognitively loaded types of tasks (Wall et al., 1985). Tasks involving external stimuli such as music or competition add still another component of difficulty. Physically awkward children may follow the same developmental sequence for skill acquisition as do other children however, the rate of development distinguishes them from their peers (Seefeldt, 1984). As well, these children tend to experience greater difficulty acquiring the mature stage of the skill and may only achieve the fundamental or initial stage of the movement pattern.

How a child acquires or does not acquire fine and gross motor knowledge and skill has long been an important concern of educators, parents and researchers. The Knowledge-Based Approach to Motor Development (Wall et al., 1985) recognizes the importance of the structural capacity and the acquired knowledge of the individual in skill

acquisition. "Structural capacity refers to the physiological, anatomical and genetic endowment that a person is born with" (Wall et al., 1985, p.28). The possibilities for structural capacity may be viewed on a continuum, with ultimate capacity characterized by boundless learning potential for any form of information. The other extreme represents a severe limitation in structural capacity that may be characterized by poor awareness of surroundings and a lack of interest in learning. This inherited structural capacity of the individual is of great importance to an individual's future development as it provides some indication of the ease by which the individual can accumulate information in all knowledge domains (Wall et al., 1985). The opportunity for ample learning experiences facilitates the individual's development to full potential. In this sense development can be viewed as the "interaction of genetic (structural capacity) and experiential factors" (Wall et al., 1985, p.29). (Acquired knowledge refers to the knowledge that is gained through experience, which should increase with chronological age). Physical awkwardness may be attributed to limitations in structural capacity, inadequate opportunities for practice or a combination of genetic and experiential factors.

During the process of development five major types of knowledge about action are acquired (Wall et al., 1985). These are procedural knowledge, declarative knowledge, affective knowledge, metacognitive knowledge and metacognitive skill. Figure one illustrates the interaction of the aforementioned knowledge bases. A brief overview of these knowledge bases follows.

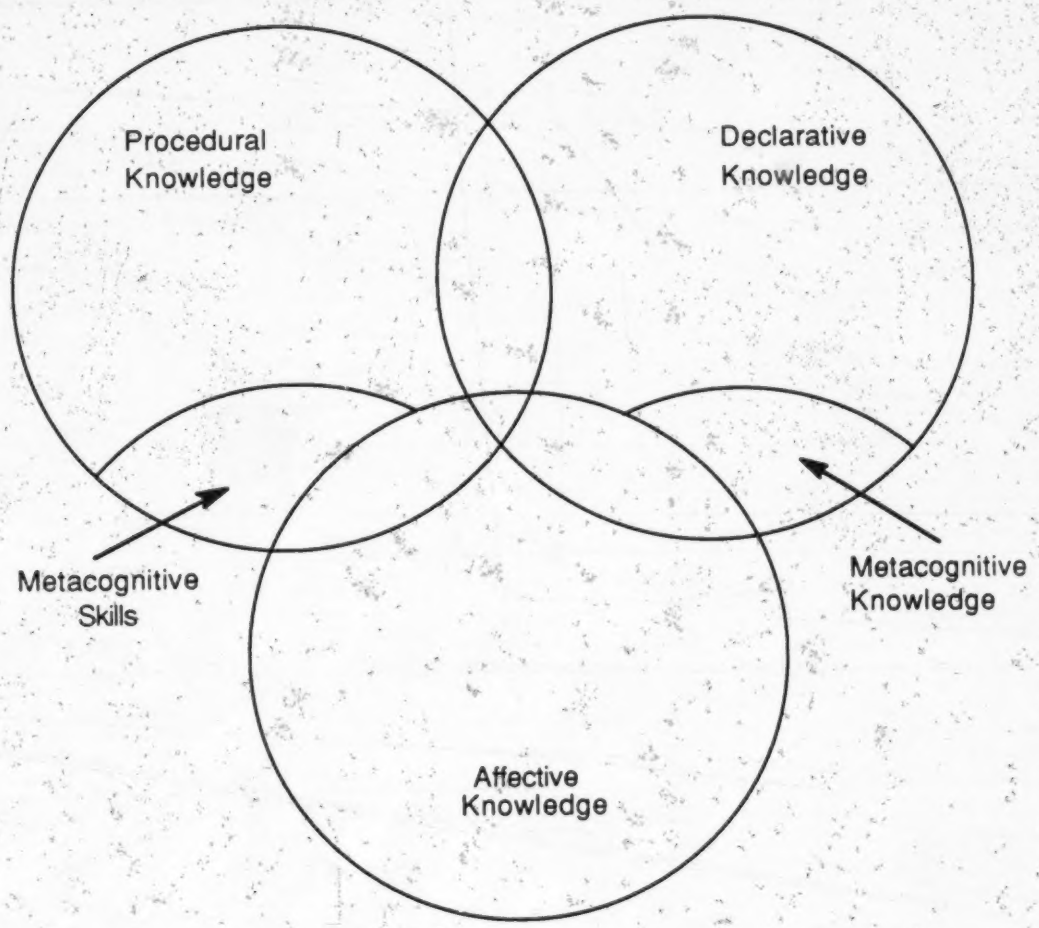

Figure 1: Interaction of the Knowledge Bases Concerned with the Acquisition of Movement.

Diagram adapted from "A knowledge based approach to motor development: Implications for the physically awkward" by A. E. Wall et al., 1985, Adapted Physical Education Quarterly, p. 32.

Procedural Knowledge

Procedural knowledge is simply knowing how to do an action. The ability to understand and perform the required movement skill in a given movement activity is based on procedural knowledge. Running, skipping or throwing rely on knowing the required movement pattern. This knowledge base "underlies the execution of all aspects of an action, including perceptual, cognitive response initiation and execution phases that will allow the individual to perform the desired movement action" (Wall et al., 1985, p.25). Procedural knowledge is stored in schema form and can be thought of as "packets of interrelated knowledge within a given domain" such as the transport skills of walking, running and skipping (Wall et al.,1985, p.25). The development of knowledge schemas is dependent on the quality and quantity of automatized skills an individual possesses, an individual's readiness for learning and the quality and quantity of practice he or she receives. Striving for good quality of practice and sufficient opportunity for practice is essential for the development of an accurate and rich procedural knowledge base.

Declarative Knowledge

"Declarative knowledge of action refers to factual information stored in memory which will influence the development and execution of skilled action" (Wall et al., 1985, p. 30). This may be in the form of increased understanding of rules and strategies derived from a knowledge base rich in information about the action. Other examples of declarative knowledge may be recall of basic movement skill sequences from the preparatory movements to the follow through or the application of the basic movement skills to sport skills. With age, maturation and

experience, an individual's declarative knowledge base expands to provide better information about action.

As declarative knowledge about action develops children "begin to attach expanded conceptual meanings to their actions, and these conceptual meanings in turn stimulate their use and understanding of their action" (Wall et al., 1985, p.31). Hutterlocker, Smiley and Charney (1983) report that actions are among the first class of concepts that children seem to develop. On the playground, for instance much of the chanting and shouting is describing movement actions. In order to utilize the knowledge of action the child must integrate the action concepts into movement sequences or procedural knowledge. Furthermore, Arend (1980) believes that individuals are better able to control their action as they increase their knowledge of the morphological, biomechanical and environmental factors. An extensive declarative knowledge base would provide the individual with better problem solving skills and therefore greater control of his or her action.

Transference of concepts occur across knowledge domains (Wall et al., 1985). An individual with a good declarative and procedural knowledge base for a movement skill or a sport skill may display an increased aptitude in the utilization of strategies (metacognitive skills) to assess, integrate and conceptualize existing knowledge in new sports or movement activities. For example, the stop performed on skates may be generalizable to the stop utilized in skiing. On the other hand, children with poorly developed knowledge bases in some domains may experience concomitant difficulties in related domains. For example, children who fail to perform culturally normative gross motor play skills may experience difficulty in the fine motor skills of printing, writing or

cutting. The ability to integrate an individual's procedural and declarative knowledge bases is important for good skill acquisition and "lies at the very heart of optimal learning". (Wall, 1985).

Affective Knowledge

An equally important and often overlooked facet of development deals with the way in which an individual perceives himself or herself, or how one feels about movement challenges. The knowledge base of the affective domain is the third major domain in the theory. Through successful positive interactions with peers, objects and the physical environment children develop movement confidence and their affinity for movement and play flourishes. Movement confidence promotes movement competence (Keogh, 1982) and this positive cycle continues. Other children who regularly accumulate unsuccessful movement and play experiences learn to dislike physical activity and may develop negative feelings about their abilities in movement situations (Harter, 1982; Keogh, 1982). These negative feelings left unattended may hinder the development of procedural and declarative knowledge. Children that may have limited procedural and declarative knowledge bases are frequently asked to perform activities too difficult for them. Weakness in these areas creates a sense of frustration and a build up of tension which further impedes the development of accurate procedural knowledge base schema. A child experiencing these weaknesses may seldom achieve a level of acceptable proficiency and often may face failure in the presence of peers or significant others. The development of a positive affective knowledge base is therefore further diminished. This may ultimately extinguish any motivation to tackle enhanced movement

challenges. As well, the cycle of failure and negative self-perception may be manifest in other behavioral problems for the child (Taylor, 1984; Gubbay, 1975; Keogh, Sugden, Reynard, Calkins, 1979). Negative feelings that arise from poor performance in the gross motor domain, for example, may be carried over into learning situations in the fine motor domain resulting in generally negative attitudes about learning and performing.

Metacognitive Knowledge and Skills

Metacognition is concerned with "knowing about what one knows or does not know " (Wall et al., 1985, p.31). Metacognitive knowledge is the individual's awareness of his or her procedural, declarative and affective knowledge base. The accuracy of this knowledge in knowing what one can and cannot do is important in initiating a plan to remedy problems and in setting realistic goals and ambitions.

The development of procedural, declarative, affective and metacognitive knowledge, allows the person to develop metacognitive skills. Metacognitive skill, is the "instantiation or use of metacognitive knowledge about action" (Wall et al., 1985, p.32). Metacognitive skills are categorized under the procedural knowledge domain and involve planning, monitoring and problem solving for motor responses. Efficient and effective metacognitive skills may be used to control what we know in action situations.

The origin of the physically awkward learner's problems are difficult to pin point. This is largely due to the heterogeneity of characteristics within the physically awkward population (Wall, 1985; Henderson, 1987). Awkwardness is normally determined by inadequate

performance in gross motor skills however, difficulty in the fine motor area frequently appears in the profile of physically awkward children. According to Wall et al. (1985, p.37) common traits observed in physically awkward children include a "delay in acquiring hand dominance, immature drawing and illegible handwriting". The frequent observation of handwriting difficulties in physically awkward children may suggest the existence of a lack of generalizable procedural, declarative and metacognitive knowledge bases. Taylor (1982) found a significantly greater risk for reading difficulties within the physically awkward population. The presence of reading and writing difficulties may indicate the possibility that physical awkwardness is also present in other knowledge domains.

According to Wall et al. (1985, p.37) "physically awkward children lack procedural knowledge in their culturally normative skills." To construct the letter forms required for the skill of handwriting the child needs procedural skills. Declarative knowledge includes the ability to memorize the alphabetic letter forms and to visualize and recall these images to mind. Monitoring the handwriting performance for consistency in slant, in keeping within the lines and in spacing of letters and words requires metacognitive skill. Therefore, to acquire handwriting skill (assuming the absence of mental deficiencies, perceptual motor limitations or physical disabilities) the individual's declarative, procedural and metacognitive knowledge bases need to be integrated.

Statement of the Problem

A main focus of this study is to examine the relationship between awkwardness in a fine motor skill (in this case handwriting) and awkwardness in gross motor skills. Lack of proficiency in handwriting and in gross motor skills may be evidence for the existence of groups of children for whom awkwardness is a general characteristic. This may be brought about by inadequately developed knowledge bases and difficulty in transfering or generalizing concepts across knowledge bases. The lack of adequately developed knowledge bases may be due to limits in structural capacity, practice deficits in these domains, the interaction of genetic and experiential factors or to lack of integration of knowledge at a metacognitive level.

If the incidence of handwriting awkwardness in the physically awkward group of children is not greater than it is in the normal elementary school population, it may be assumed that there is more specificity than generality in awkwardness. The presence of awkwardness in either handwriting or gross motor skills may more likely be attributable to specific practice deficits, or to specific limitations in genetic endowment or structural capacity. In order to gather this information on awkward children the incidence of handwriting difficulties for the normal population must first be determined and then compared with a group of awkward children. As a result, the following questions will guide this research.

1. What is the incidence of handwriting difficulties in a sample of students in grades four, five and six? Other questions examined include the relationship of gender and handwriting and the teachers' responses to the students' performance at the various grade levels.

2. What is the reliability of the Handwriting Performance Rating Checklist (H.P.R.C.)?

3. What is the stability of handwriting difficulties from one year to the next year?

4. What is the incidence of handwriting difficulties within a physically awkward group of students?

CHAPTER TWO

REVIEW OF THE LITERATURE

Gross and Fine Motor Development

Physical awkwardness may be manifest in fine motor and/or gross motor coordination (Gordon & McKinlay, 1980). Research in physical awkwardness is generally restricted to the gross motor area. Difficulty in some aspects of the fine motor area is cited as a characteristic associated with awkwardness however, research in this area is limited. Walton, Ellis and Court (1962) found that children identified as physically awkward demonstrated awkwardness in the skills of dressing, feeding and walking and also displayed great difficulty with the fine motor skills of writing, drawing and copying.

In the early years, culturally-normative fine motor skills involve manipulative movements such as writing, drawing, copying, cutting and grasping. The degree to which the child can perform these small movements results in part from fine motor development. Lack of progress in these movements may indicate physical awkwardness in the fine motor area (Walton et al., 1962; Gordon & McKinlay, 1980; Geuze & Kalverboer, 1987). Other possible explanations may be perceptual motor problems, limited structural capacity and physical disabilities

Handwriting is a very specific fine motor skill that is largely taken for granted by that portion of the population that have successfully learned the perceptual and motor skills it requires. Hagin (1983) and Luria (1973) describe handwriting as a complex visual, motor, body-image, kinesthetic, verbal skill. In Hagin's (1983, p.268) words, "human

movement involves assessment of both afferent and efferent information and aspects of body image from within, accurate perception of the visuo-spatial coordinates in which the movement occurs, interpretation of feedback and timing of corrections, all under the regulatory control of communication processes." It is not surprising that handwriting provides a significant obstacle to some children.

In the classroom, legibility of handwriting is important to both the child and the teacher. Trying to read poor handwriting or unreadable numbers in math may create negative feelings in the teacher. The resulting irritation and frustration may result in the lower grading of the student. Research provides evidence that children whose handwriting is difficult to read receive lower grades regardless of content (Briggs, 1970; Groff, 1984). Furthermore, Phelps-Terasaki, Phelps-Gunn & Stetson (1983) agree that handwriting and spelling are prerequisite skills to the writing of school compositions. He states that "only after a sense of competence in these mechanics is reached do children begin to play and practice with words and phrases " (p.305).

Brenner, Gillman, Zangwill and Farrell (1967) conducted a longitudinal study (3 years) of 14 eight or nine year old children experiencing visual - motor difficulties in their daily activities, that is they displayed illegible writing and their work was completed in a somewhat messy manner. The teachers were asked to assess these children on their academic progress, attitude and sociometric status. Reports most often received from the teachers indicated that these children were below average in spelling, handwriting and arithmetic skills. As well, the children were cited as being in a group that was considered untidy, lazy, unpopular, irritating and awkward in fine motor skills.

Taylor (1984, p.2), describes a cycle of negative behavior children exhibit as a result of poor gross motor performance. The less skilled individual frequently avoids physical activity. A cycle of less practice will produce a weak performance. The awkward movement skills frequently are a source of embarrassment and ridicule and the child may misbehave in an attempt to mask the inadequacy. Children at a very early age are aware of the importance of good physical ability and admire and emulate skilled athletes. Perhaps children presenting poor fine motor skills also fall prey to this downward spiral of behaviors. The frustration turns into a withdrawal from the handwriting task, resulting in a weak performance and a decline in motivation to attempt other learning tasks that involve handwriting.

Knowledge Based Approach and Handwriting

Procedural Knowledge and Handwriting

Procedural knowledge stored in schema form underlies all aspects of an action sequence including the stimulus identification, perception, decision making, response selection and execution, and the evaluation of intrinsic and extrinsic feedback (Singer, 1980; Norman & Shallice 1980; Gallistel, 1981; Stelmach & Diggles, 1982; Wall, 1985). According to Luria (1973) and Stott, Henderson & Moyes (1987), the initial stages of writing depend on memorizing the cognitive and visual form or schema of each letter. Stott et al. (1987, p.143) proceed to state that "the schema of the letter must be translated into a movement sequence" for a meaningful graphic product. A number of external teaching aids such as visual imagery and acoustic representation (declarative knowledge) will assist to achieve the desired product.

Through practice, the schema becomes internalized, condensed and transformed into an automatic skill that no longer requires prompts. For many people, their signature is an example of automatized skill acquisition. It is a routine type of schema with its procedure summoned through language with no conscious effort, thereby allowing the individual to concentrate on the message to be communicated.

When learning a new skill or when performing a difficult or dangerous skill, conscious control is required (Wall et al., 1985). When a difficult or novel skill is presented to an individual, recognition of the correct control schema required to produce the desired action response is more difficult. The novel task requires a higher degree of conscious control than the more familiar task. Therefore the time required to process the information and summon the appropriate schema is increased. For example, a skilled performer may need to employ conscious control in the case of signing a cheque while using a friend's back as the writing surface or when using a fountain pen or a piece of chalk. As the task and response pattern are practiced, familiarity with the motor schema will enable the individual to perform the action quickly and with less conscious control and thus the response occurs automatically. An individual's procedural knowledge base can be evaluated in terms of the quality and quantity of automatic skills learned and the ability to generalize this information to other action sequences (Wall et al., 1985).

The crucial role of culture and practice in the development of procedural knowledge needs to be recognized. In their work Saida and Miyashita (1979) studied pencil manipulation of British and Japanese children. It was found that Japanese children are more advanced than British children at about three years of age in the manipulation of a

pencil. This may be explained by the the fact that during meals British children use a knife and fork which are held in a pronated position, while Japanese children use chopsticks that are held and used in the dynamic tripod position. This provides for a much greater opportunity for practice and acquisition of the basic procedural skill and therefore a superior skill performance in the manipulation of a pencil.

Declarative Knowledge and Handwriting

Declarative knowledge is "factual information stored in memory which will influence the development and execution of skilled action" (Wall et al., 1985, p. 30). Declarative knowledge includes information on the morphological, biomechanical and environmental factors that constrain movement (Arend, 1980). The morphological factors provide information on body awareness and handwriting posture by means of afferent and efferent nerve impulses. The declarative knowledge in the form of body awareness required for handwriting is the information on the position of the limb in space and the monitoring of task requirements from one action to the next. This process would incorporate an "accurate perception of the visual spatial coordinates in which the movement occurs, kinesthetic signals and information concerning muscle tone and equilibrium" (Hagin, 1983, p.268). This information provides necessary feedback to evaluate and adjust performance. As well, handwriting involves the controlled use of two hands working together. As one hand positions and adjusts the paper the other hand moves the pen to produce legible letter forms. This bilateral motor coordination requires substantial declarative knowledge about the timing and spacing of these movements.

Biomechanical factors affecting handwriting may be knowledge of the pressure exerted in the handwriting grip, the force of the pen/pencil stroke and the movement of the free hand across the page.

Environmental constraints include spatial orientation and the temporal sequencing aspects of the performance. For example, a child who has difficulty lining up words/letters and leaves insufficient or excessive spaces between words/letters may require special lined paper or an appropriately angled desk to reduce the task difficulty and provide additional environmental cues for the performance. Other environmental factors affecting handwriting performance are writing surface, position of the paper in relation to the body, writing instrument, the quality of past teaching and possible psychological reasons such as stress at home, relationships with teachers and/or other students.

As alluded to previously, an important facet of declarative knowledge is information about body awareness (Wall et al., 1985). Williams (1983) draws from the work of Nash (1970, p.461) who describes body awareness as an intermediary step between the development of body schema and body image. Body awareness is defined as "the conscious awareness and identification of the location, position and movement of the body and its individual parts in space, the interrelationships among these body parts, and the relationship between the body and its parts to the external environment." The development of body awareness is dependent upon the early sensori-motor experiences, (e.g. kinesthetic and haptic) involved in the development of a "body schema." Furthermore, Nash believes that the body schema is "the diagram of the body that is built up in the brain (probably in a definite location) by which coordinated purposeful movements are carried out

and by which the body parts and the body itself are oriented in space." (as cited in Williams, 1983, p. 461).

Control schemata within an action sequence can activate related schemata in both the declarative and procedural knowledge bases. This interplay appears to be an important variable to learning. For example, writing depends on the ability to memorize the alphabetic letter forms and to visualize these images in the mind (declarative knowledge). The procedure of isolating motor impulses to construct the graphic illustration of the letter forms whether it be a vertical, diagonal or circular movement is procedural knowledge. To perform the skill of handwriting, it appears that the procedural and declarative knowledge bases are very dependent on each other.

Affective Knowledge and Handwriting

As children broaden their procedural and declarative knowledge base they attach subjective feelings to their actions. The subjective feelings form an affective knowledge base. Negative feelings about handwriting, decreases one's confidence, self esteem and motivation to tackle other tasks involving handwriting (Groff, 1984). Successful experiences generate feelings of confidence (Harter, 1982). Movement confidence generates movement competence (Griffin & Keogh, 1982)

As well, experiences of failure may lead to a negative self-concept and learned helplessness (Mahon, 1983). Learned helplessness is characterized by a lack of motivation and persistence in task completion. Motivation problems and a sense of helplessness are compounded by other demands. For example, in school students may be required to complete written work from oral or visual presentation under time

constraints. This demand encourages shortcuts in letter formation and spacing that result in an illegible product. An unreadable or illegible product may result in criticism by a frustrated reader. These experiences may act as strong negative reinforcers and discourage the handwriting practice required for improvement. The importance of motivation to the learning process is critical.

Metacognitive Knowledge and Handwriting

Metacognitive knowledge refers to the individual's awareness of what an individual can and cannot do. It is based on an awareness of the procedural, declarative and affective knowledge bases. Metacognitive knowledge about action increases with age and experience (Wall et al., 1985) as children become aware of what they can and cannot do in a variety of action situations. Harris and Herrick (1963) investigated the ability of bright, average and slow learners to form normative and aspirational models for their handwriting. Normative perception has to do with the child's ability to identify a sample of handwriting as like their own. Aspirational perception is concerned with the model a child sets as a goal for himself or herself. Results indicated that the ability of a child to pick out a handwriting sample like his or her own must be well established before he or she can expect to modify handwriting or use an aspirational model to produce change in handwriting performance. As Knapp (1963, p. 64) points out in reference to Lewin's Level of Aspiration Theory "the level of aspiration of a learner is important for it has been found that the good student is one who tends to set a level of aspiration just a little above past achievements."

Metacognitive Skill and Handwriting

"Metacognitive skill refers to the instantiation or use of metacognitive knowledge about action" (Wall et al., 1985 p.32). It is a more sophisticated form of procedural knowledge about action and is often used in problem solving situations when planning, monitoring, evaluating and predictions are needed (Wall, 1985; Brown, 1977). A good metacognitive knowledge base would include a repertoire of learning strategies to accomplish the task. This would differ for each individual learner according to his or her skill level. An example of a metacognitive skill particularly useful for the motor domain is the ability to mentally plan and rehearse future actions. Other strategies include modelling behavior using verbal cues and biofeedback technique, and problem solving. In technically difficult situations, children often use some deliberate attentional control creating a condition of utilizing part procedural and part metacognitive knowledge. In the skill of handwriting, conscious control may be required in aligning words on a chalkboard or for example when writing with a fountain pen or a large tipped felt marker.

Motor Assessment Tools

Much research suggests that the earlier children are identified and provided with programs of remediation the more likely improvement or learning to cope with motor limitations will occur (Gordon & McKinlay, 1982; Haubenstricker, 1982; Wall & Taylor, 1983). Identification of those children who have fine motor development difficulties is a very important first step. According to Stott et al. (1985) the lack of an identification tool

for analyzing handwriting faults is one reason that handwriting has been a neglected area of study.

Most tests of motor proficiency focus to a large extent on the gross motor skills. For example, of the eight sub tests listed in the Bruininks Oseretsky Test of Motor Proficiency (1978) three of them measure fine motor skills. The fine motor tests include response speed, visual motor control (card sorting, cutting with scissors and using a pencil to mark a straight line within a narrow boundary) and upper limb speed and dexterity. Are these tests sensitive enough to detect weaknesses in printing and handwriting skill? Stott et al. (1985) observed poor hand writers who did not have gross motor problems. This was also observed by Sovik (1984, 1987) in a group of children he referred to as dysgraphic.

The tasks selected for motor proficiency are not culturally normative. They contain little real world connection. (i.e. use of bead threading card sorting and displacing pegs). An important strength of a good test battery is that the actual skills practiced are those required for an individual in the normal course of life. The Gubbay (1975) test items of bead threading and peg displacement are not culturally normative tasks for a child in most modern day western societal settings. It may be more appropriate as a culturally normative fine motor skill for school age children to be assessed in performing tracking, tracing or copying activities using pencil, paper, chalk and chalkboard.

A major teacher complaint is in the time required for assessment purposes. For example the time required to administer the short form of the Bruininks Oseretsky Test of Motor Proficiency by an experienced individual is 25-30 minutes. This may be a serious concern for the classroom teacher, parents and the child being withdrawn from class.

However, if the test items were culturally normative (tracking, tracing and copying exercises) and thereby reinforcing the acquisition of skills already being taught, the assessment sessions may be regarded as contributing to the child's educational program rather than as an abstract testing procedure.

A major criticism is in the procedure utilized for motor skill proficiency assessments. They are often conducted on an individual basis by a visiting clinician. This frequently used method for conducting assessments appears to be overly clinical and artificial. Unless children are being observed and assessed within the regular daily social setting (Lord and Pepler, 1979) measurements may not reflect their true abilities or difficulties/limitations.

Most tests describe the observed movement outcome in terms of performance deficits rather than establishing movement strengths from which to build a suitable program. A description of the movement outcome as outlined in many of the tests provides the test administrator with an inventory of tasks the individual has difficulty performing. However, the most essential matter of interpreting the test results is not only finding the source of the difficulty but establishing what the child can do, identifying the stage of development the child is performing at in the areas of manipulation, locomotion and balance ability and implementing remedial programming accordingly.

Research In Handwriting

The Handwriting Performance Rating Checklist (H.P.R.C.) was developed by the author to screen children that are suspected of having handwriting difficulties. Rondinella (1963) found that teachers were often

subjective in their rating of handwriting samples. When asked what criteria were used in their evaluation, teachers named 14 items, only 5 of which are considered significant on the Freeman Scale (1959). The Freeman scale outlines the general qualities of handwriting in terms of legibility (1959). Otto , Askov & Cooper (1969) found that once teachers were trained and familiar in the use of a handwriting scale they can rate handwriting samples without the use of the scale. The suggestion is that the teacher internalize the criteria for making the judgement of handwriting performance.

The assessment should include a variety of copying and free writing tasks. Samples of written work for all subject areas should be studied in order to gain a better idea of how the child writes in his or her daily work.

An in-depth test such as the Diagnosis and Remediation of Handwriting Problems by Stott, Moyes and Henderson (1985) should then be used to confirm the identification. Other information this test will provide is the nature of the handwriting fault and a starting point for a program of remediation.

Handwriting Performance Rating Checklist

The ten questions on the H.R.P.C. were selected from written reports of classroom teachers and the handwriting difficulties often experienced by students in their classes. These questions focus on the following parameters:

1. pressure placed on the paper
2. body tension
3. writing grip

4. writing in terms of legibility
5. letter formation
6. letter alignment
7. spacing of words
8. slant of letters
9. reproducing material
10. completing assignments.

The first three questions on the H.P.R.C. focus on the pressure being placed on the paper, body tension and the handwriting grip during the writing performance. The pressure placed on the paper and body tension are observable negative behaviors associated with the appearance of the writer. Squeezing the pencil tightly and pressing down hard on the paper produces stress and fatigue that may restrict the free flowing movement required for good handwriting.

In a study conducted by Sovik, Arntzen and Teulings (1982) the kinds of deviations from the ideal of handwriting grip, position of the fingers, hand etc. was examined. The study involved thirty grade three students and was carried out in a combined classroom and laboratory situation. The ideal grip is characteristic of the tripod posture. A thorough observation and rating procedure was followed to determine the children deviating from the ideal handwriting grip. It was found that the majority of third graders (80.0%) do not practice the prescribed model in their handwriting and coordination of the hand movement was unsatisfactory. It was found that many children wrote with an extended right turned hand which was often overly pronated. Almost every child in the study held his or her fingers in a hyperflexed and stiff position, and the finger position on the pen was too low. A high incidence of

underdeveloped arm and finger movements and a high level of muscle tension in the fingers was also found. As a result of this high muscle tension in the fingers there seemed to result a corresponding heavy grip and pressure on the pen and paper. The high incidence of grade three children unable to utilize the tripod grip in handwriting may suggest that grade three children are not yet at the mature stage of development in their writing grip.

Rosenbloom and Horton (1971) observed two stages of the tripod grip, these being the "tripod posture" and the "dynamic tripod posture". The tripod posture utilizes movement of the wrist however the small coordinated movements of the fingers are not yet present. The mature, dynamic tripod is characterized by movement of the thumb, index finger and middle finger functioning together to make small, highly coordinated movements of the fingers and wrist. Zivani (1983) found that the "tripod grip" became progressively more refined in children between the ages of 7 and 14.

Question number four of the H.P.R.C. is concerned with the legibility of the handwriting. Herrick & Erlbacher (1963) indicate that writing legibility is the main criteria of the writing process parameters. They define handwriting quality in terms of "legibility" or "quick readability", excluding "pleasing appearance". These descriptors do provide a readily observable measure of handwriting skill however, they seem to provide information only on the finished product and appear to ignore parameters such as letter spacing, slant, alignment and formation involved in the handwriting process.

Askov, Otto & Askov, (1970) suggest that research is needed to determine the influence of handwriting characteristics on legibility.

Available literature repeatedly states that legibility of print is affected by letter form, letter size, spacing of letters within words and between words, letter alignment and the uniformity of slant (Zivani & Elkins, 1984; Alston, 1983; Bell, 1970).

In a comprehensive study by Zivani & Elkins (1984) legibility components were assessed for 575 children in grades three through seven. Factor analysis indicated that letter formation, spacing, alignment and size were "discriminable elements" of legibility. According to Bell (1970) the most important factor to be considered in determining legibility is the recognition of letters. Each letter should be recognized at sight and not be confused with another.

It is important to rule out the possibility of visual problems as the role of vision in the development of highly refined fine motor skills is important (Pyfer, 1988). Continued experiences integrating the feedback from visual (seeing) and nonvisual sensory (feeling) stimulation is essential for the development of refined fine motor control. According to Pyfer (1988) two aspects of vision are important to motor development. These are refractive and orthoptic visual development. Refractive vision refers to the way the visual image is processed within the eye. Examples of refractive types of problems are farsightedness, nearsightedness and astigmatism. This type of problem can usually be corrected by wearing prescription glasses. Orthoptic vision refers to the efficiency of the eyes working together. When the eyes do not work in unison, two different images will occur resulting in depth perception problems. To copy from the board, to write on the line, to evenly space letters and words requires good refractive and orthoptic vision.

Other parameters affecting legibility are presented in questions numbers five, six, seven and eight of the H.P.R.C. These inquiries are to investigate the elements of letter formation, letter alignment, spacing of words and slant of letters.

Poor letter formation reduces the legibility of print more than any other element and usually receives the greatest emphasis in teaching children to write (Graham & Miller, 1980). Incorrect letter forms may make the writing hard to read. Over 50% of the illegibilities in handwriting result from the improper writing of only a few letters (Groff, 1985). These letters are n, e, o, s, t, a, r . Other studies examining children's handwriting indicate that the letters a, e, r, t account for about 50% of the illegibilities at any grade level (Graham & Miller 1980; Graham & Madan, 1981).

To form letters correctly children must have several sub skills (Lindsey & Beck, 1984). These are:

1. laterality,
2. visual perception,
3. eye-hand coordination,
4. proper posture and writing position,
5. easy and comfortable pencil grasp,
6. mastery of left to right progression,
7. motivation to learn to write,
8. ability to copy shapes, copy general letter strokes, copy single or groups of letters and
9. ability to write letters from memory.

It is interesting to note that incorrect letter formation may become a trademark for some individuals. In a study of up to 300 samples of

children's writing it became apparent that many of the faults in the handwriting samples are due to ignorance of the correct letter form or word and letter spacing or "stylistic idiosyncrasies" that children pick up to express their individuality (Stott et al., 1985). To accommodate personalized letter forms that can decrease legibility, a teacher should consider a letter legible if it can be easily and quickly read and written.

Poor letter or number alignment is another source of illegible handwriting. It produces work difficult to read and frustrating to work from. For example, the difficulty encountered in doing mathematical problems that require number alignment to identify operations and expressions. A likely reason for this type of fault may be perceptual motor limitations producing poor motor control. This may include failure of hand eye coordination (Stott et al., 1985). The authors caution that where a motor handicap is suspected, a diagnosis of neurological deficit should be postponed until a program of remediation is attempted to determine how the child responds to remedial instruction.

Serious problems in handwriting usually become evident when children are required to switch from printing to handwriting. A distinct element here is spacing of letters and words. The slower stop and start motion characteristic of printing allows for more time to process the information required for correct spacing of letters and words. According to Stott et al. (1985) when the activity comes to spatial aspects of writing, the difficulty is in determining whether the problem is with a fault of concept or in an inability to handle spatial relations. In other words, a child having difficulty leaving the correct spacing between letters and words may do so from a lack of information or knowledge, from a

perceptual disability or simply because the child requires corrective glasses.

It is important to note that although serious problems will frequently show up when children move from printing to handwriting it is not the increased difficulty of handwriting that is the cause. Research indicates that handwriting rather than printing is probably easier for children to learn since many letters ("l", "e", "i", "o") have similar movement patterns to that of scribbling (Cratty, 1975). As well, handwriting prevents the reversal of letters common in printing. This brings into question the whole curricular structure of early years education. Printing skills are developmentally more difficult than the writing skills but are introduced in the early elementary school years. Writing is introduced in the later stages of development and is then the expected norm for most written communication.

An important factor affecting the slant of letters in handwriting is posture. Croutch (1969) claims that difficulties in handwriting often arise from improper body posture and paper positioning. Good balance and posture promotes muscle relaxation to efficiently control the fine motor movements. Stott et al. (1985) classify inconsistency of letter slant as a fault of control. The authors state that the most likely cause for these types of fault is poor motor control, including failure of hand-eye coordination and/or a neurological origin.

To be successful in our educational system one must be able to take notes, write examinations and complete assignments in a reasonable amount of time. Current research suggests that an assessment tool is not complete without including speed of handwriting as a facet of legibility (Askov, Otto & Askov, 1970). Research providing

guidelines with regard to handwriting speed does not appear to have been updated since the work of Freeman (1954). Freeman provided norms for handwriting speed in terms of legible letters produced per minute. He found that between grades two and eight, children's speed increased from 30 letters per minute to 80 letters per minute.

Discussion of Fine Motor Difficulties

The effective performance of handwriting demands that it be carried out with a certain timing and speed. A child who is unable to execute the motor programs in a fluent fashion may suffer great frustration. In a study by Geuze and Kalverboer (1987) a continuous tapping task was used to study the variability in time intervals (inconsistency in reproducibility) and adaptations to a change in task speed. The results suggest a general timing problem in clumsy children and problems in adapting to external task demands. Both conditions have consequences to learning and utilizing instructions effectively. Because the outcome of a movement (conscious visual perception of the features of the letter) is used as feedback to improve subsequent performances and physically awkward children experience problems in processing stimulus information simultaneously into an adequate response they may not benefit from this knowledge of results. The notion of the importance of feedback is essential to the work of Sovik (1982, 1984, 1987). He feels that sensory (internal feedback) as well as supplementary feedback (external feedback) needs to be employed if the learner is to progress in improving handwriting skills.

According to the Knowledge Based Approach to motor skill acquisition (Wall et al., 1985) procedural knowledge stored in schema

form "underlies the instantiation of all aspects of an action sequence including the stimulus identification, perception, decision making, response selection and execution, and the evaluation of intrinsic and extrinsic feedback". In other research (Singer, 1980; Norman & Shallice, 1980; Gallistel, 1981; Stelmach & Diddles, 1982) findings suggest that an inability to execute motor programs or schemata in handwriting may be due to a developmental lag in the procedural knowledge base. The holistic nature of the knowledge base approach emphasizes the impact a deficit in one knowledge base has on the others. The knowledge bases are not mutually exclusive entities. There is a need for the knowledge bases to be nurtured together for optimal success.

CHAPTER THREE

METHODS AND PROCEDURES

Part one of the study investigated the incidence of handwriting difficulties in a randomly selected group of students in grades four, five and six. The relationship of gender and handwriting difficulties as well as a grade level difference in teachers' responses to student performance was also examined. Part two of the study examined the reliability of the H.P.R.C. Part three of the study examines the stability of handwriting performance over two years. Part four investigated the incidence of handwriting difficulties in physically awkward subjects.

Handwriting Performance Rating Checklist

A ten question Handwriting Performance Rating Checklist (H.P.R.C.) was developed to assist classroom teachers to evaluate handwriting performance (see Appendix A). By outlining ten basic elements of good quality handwriting based on procedural, declarative and metacognitive knowledge and skills, the H.P.R.C. provides the teachers with parameters critical in the evaluation of handwriting performance. The checklist is designed as a prescriptive instrument that will enable the teacher to identify the area of difficulty for a program of individual instruction.

Prior to addressing the ten questions of the checklist, the teacher's overall impression of the child's handwriting performance is established. The teacher will respond "yes" I am concerned about the handwriting

skills of this child or "no" I am not. Other information obtained at this time is gender, age and grade.

The ten questions of the Handwriting Performance Rating Checklist were developed as follows:

1. A collection of handwriting samples and comments were submitted by elementary school teachers from urban schools in Winnipeg, Manitoba. The areas most frequently reported as contributing to illegibility were included in the H.P.R.C.. These areas were inconsistency of slant, letter size, spacing between letters and words, body posture during handwriting performance and writing speed.

2. A selection of specific items were generated from previous research conducted in handwriting studies. The research included findings from D.H. Stott, F. A. Moyes, S.E. Henderson (1985, 1896, 1987), N. Sovik (1982, 1984, 1987), J. Zivani (1983, 1984), R. Hagin (1983),

3. The information generated by the teachers and review of literature was compiled into a ten question checklist and subjected to review by colleagues (6), peers (10) and student advisors (2). The reviewers were instructed to answer the following questions: a) Are the items good descriptors of handwriting performance? b) Are the descriptors of the handwriting performance clearly written?

The ten questions of the H.P.R.C. address various parameters that contribute to handwriting performance. Likert type responses for each question describe less desirable and more desirable characteristics of handwriting performance. The two responses falling to the left half of the page describe poor handwriting qualities and the two responses falling to the right of the page describe good handwriting qualities. The exception to this was in question number one and number two where the third item described the most desirable characteristic of the handwriting item.

The first two questions address writing pressure, body tension and grip posture. These elements are easily observable during the handwriting performance and may be indicative of the student's procedural skill in writing. As writing pressure and body tension increase one may observe a 'shoulders up' position and/or an overflow of tension into the facial muscles. This position appears to provide a perceived sense of stability and better control. As well, the child may use excessive pressure on the paper to provide an increased awareness of sensory feedback from the muscles and joints.

Question number three addresses the pencil/pen handwriting grip. Handwriting grip follows a developmental sequence (Rosenbloom & Horton, 1971). The teacher should be familiar with this sequence in order tc evaluate deviations from the norm. In question number four the legibility of the handwritten product is examined. The teacher should be concerned with the appearance of the handwriting and its easy readability.

Questions number five, six, seven and eight address letter formation, spacing and slant of the handwritten product. The handwritten

response may indicate a visual limitation, a lack of adequate procedural, declarative and/or metacognitive knowledge.

Question number nine addresses the child's ability to "keep up" with classmates in exercises that involve copying from the chalkboard. The question attempts to identify if excessive effort and concentration to copy the message is the reason the child cannot "keep up" to the others. Question number ten deals with completing written assignments and tries to identify if the obstacle to completing assignments is handwriting. In the last two questions the existence of learning disabilities has not been ruled out.

The criterion used to indicate concern for handwriting performance was the judgement of the teacher in the initial question of the H.P.R.C. that addresses concern for handwriting performance or lack of concern. This question does not provide information concerning the writing performance or the extent of the concern.

Part One

Part one of the study identifies the incidence of handwriting difficulties in randomly selected students in grades four, five and six. The relationship of gender and handwriting difficulties as well as a grade level difference in teachers' responses to student performance was also examined.

Subjects

The subjects were randomly selected girls and boys from rural and urban elementary schools in Manitoba, Canada. To ensure randomization of subjects, a six digit random number was given to

each of the teachers. The teachers were instructed to count down their class list of boys the number of the first digit and to complete a rating checklist on this subject. This same procedure was continued, alternating boy-girl, to attain the remaining five subjects. The subjects were from urban and rural Manitoba schools. The subjects were from grades four, five and six and were nine, ten and eleven years of age.

Procedure

Teachers of grades four, five and six in eleven elementary schools received written instructions on the procedure for completing the ten point H.P.R.C. for six of their students (three girls and three boys) (see Appendix B). The teachers were asked to answer all of the questions for each child and to check only one description for each question. Prior to answering the ten questions, the teachers were instructed to indicate their overall evaluation of the child's handwriting performance. The teachers indicated a concern or lack of concern for the child's handwriting performance.

The returned H.P.R.C. were analyzed to determine the frequency of responses indicating a concern for handwriting performance or a lack of concern for handwriting performance. This information provided overall percentages. The relationship of gender and handwriting performance was analyzed through Chi Square. All of the frequencies used in the Chi Square calculations were in proportion to the number of subjects in each specific group.

Part Two

Part two of the study examines the reliability of the Handwriting Performance Rating Checklist. The reliability of the H.P.R.C. is established for a group of grade seven students.

Subjects

The subjects were sixteen grade seven boys and girls from elementary schools in the River East School Division # 9 in Winnipeg, Manitoba Canada. Of the 16 subjects seven were males and nine were female.

Procedure

Each grade seven subject was rated by two grade seven teachers familiar with their handwriting skills (32 teachers were involved). Instructions on procedure were given verbally to a selected grade seven teacher in each of the four schools. These instructions (see Appendix C) were followed up by a letter. The grade seven teachers then passed a second H.P.R.C. to one other grade seven teacher and provided the procedural instruction both verbally and in a written format.

The two grade seven teachers rating the same subject were given the same sample of the subject's handwriting and were instructed to answer questions number four, five, six, seven, and eight of the H.P.R.C. Through observation and from past experiences with the student the teachers were asked to complete questions number one, two, three, nine and ten.

The interobserver agreement scores were calculated by using each question (10) of the H.P.R.C. for each subject (16). This yielded 160 data points for comparison of teachers scores. Using a point by point comparison of the questions in exact agreement and in disagreement between the two teachers the percentage agreement was determined. Also, a less conservative analysis, where agreement including same and similar evaluation characteristics was used to show interobserver agreement. For example, in question number seven concerning the spacing of words the same or similar characteristics would be "no difficulty" and "little difficulty". For this analysis, question number one was excluded. The exclusion of question number one concerning "pressure on the paper when writing" was due to unrelated same side characteristics.

Part Three

Part three of the study examines the stability of handwriting difficulties from one year to the next? The results may indicate that handwriting is a stable characteristic of the student.

Subjects

The subjects were selected on the basis of their involvement in the study in grade six, from the previous year. The subjects were sixteen grade six boys and girls from elementary schools in the River East School Division in Winnipeg, Manitoba. Of the 16 subjects seven were males and nine were females.

Procedure

Subjects from the River East School Division having been rated by their classroom teachers on the performance of their handwriting skills (Handwriting Performance Rating Checklist) in grade six were rated by their new teacher in grade seven. Results should provide information on the handwriting behavior over the two years. The subjects were rated in February of their sixth school year and in May of their seventh year of school. This would allow sixteen months between teacher ratings.

The interobserver agreement scores were calculated by using the same procedure as described in Part Two.

Part Four

Part four addresses the incidence of handwriting difficulties in subjects identified as physically awkward? These results may provide additional evidence to suggest a link between handwriting difficulties and physically awkwardness.

Subjects

The physically awkward subjects were grade four, five and six year old boys and girls from five urban elementary schools in the River East School Division in Winnipeg, Manitoba. Of the twenty-nine subjects identified as physically awkward, eighteen were male and eleven were female.

The initial screening of subjects was by Physical Education Specialists. The criteria for selection was through observed physical difficulties in performing movement requirements during

the physical education class. Children identified as experiencing difficulty in the performance of the movement requirements during class where given a more in depth test of motor proficiency designed to assess performance of their basic movement skills. The screening and testing devices are based on an in-house test of gross motor proficiency entitled "The Basic Movement Skills Checklist" (see Appendix D).

The children confirmed as experiencing difficulty in two or more ability areas formed the "physically awkward" group. Ability areas are grouped according to type of skill and are as follows:

1. Transport skills - run, jump, gallop, hop, skip

2. Manipulative Skills - catching, throwing

3. Balance ability - static and dynamic

Procedure

The teachers of the children identified as physically awkward were asked to complete a Handwriting Performance Rating Checklist for the child. The returned H.P.R.C. provided information on the incidence of handwriting difficulties in this group by gender and grade.

Research Design

The research design involved subjects from three grades (four, five and six), and mixed gender (male, female). Descriptive and inferential statistics were generated where appropriate.

CHAPTER FOUR

RESULTS

Part One

Part one of this study was to identify the incidence of handwriting difficulties in grades four, five and six students. The results will provide the data for gender and grade level for teacher responses to concern for handwriting performance. Chi Square analysis was used to determine significant difference for gender and grade level. The percentages of responses on each question of the H.P. R. C. conclude this section.

Table 1 provides a breakdown of data for subjects according to gender, grade level and teacher concern for handwriting performance. Prior to addressing the ten questions of the checklist, the teacher's overall impression of the child's handwriting performance was established. As previously mentioned, this was based on the objective evaluation or judgement of the teacher. The teacher responded "yes, I am concerned about the handwriting skills of this child" or "no I am not".

A total of two hundred and eight Handwriting Performance Rating Checklists were distributed. Of the 208 H.P.R.C. distributed 106 checklists were returned. Sixteen teachers each returned a set of six checklists. Of the 106 checklists returned, 58 were completed on female students and 48 were completed on male students.

The criterion used to indicate concern for handwriting performance was the judgment of the teacher in the initial question of the H.P.R.C. that addresses concern for the student's handwriting. The total of 32 responses (29.9%) indicated a concern for the handwriting performance

of the student. Seventy five responses (70.1%) indicated a lack of concern in the handwriting skill of the student.

A comparison of the proportion of children across the grades about whom the teachers expressed concern (see Table 1) indicated that the percentage was fairly consistent (31%, 31% and 27% in grades 4, 5 and 6 respectively) over the three years (X^2=.279).

Table 1

Concern for Handwriting Performance According to Grade and Gender

		Grade 4 (n=34)		Grade 5 (n=35)		Grade 6 (n=37)	
		%	N	%	N	%	N
Concern for handwriting performance	Total	31.4%	11	31.4%	11	27.0%	10
	Male	53.1%	9	47.0%	8	43.0%	6
	Female	11.8%	2	16.7%	3	17.4%	4
No concern for handwriting performance	Total	67.7%	23	68.6%	24	73.0%	27
	Male	47.1%	8	53.0%	9	57.1%	8
	Female	88.2%	15	83.3%	15	82.7%	19
Subjects	Total	32.1%	34	33.0%	35	34.9%	37
	Male	50%	17	48.6%	17	37.8%	14
	Female	50%	17	51.4%	18	62.2%	23

N=106; male=48, female=58.

Of all female subjects, approximately 15.0% (9 of 58) were identified as students about whom the teacher had a concern for handwriting performance. At the same time, approximately 48.0% (23 of 48) of all males were similarly identified. This indicates a clear difference

in the proportion of males and females with handwriting difficulties as was judged by their teachers. A Chi Square analysis for each grade level revealed a significant difference between males and females and teacher concern for handwriting difficulties in grades four and five. (X^2 (1, N=34)=6.83, $p < .05$; X^2(1, N=35)=3.92, $p < .05$). In grade six the difference was not significant. (X^2 (1, N=37)=2.9, $p < .05$). (Table 2).

Table 2

Chi Square Analysis of Handwriting Performance as a Function of Grade and Gender

Grade	Gender	'Concerned' for Handwriting Performance	No Concern for Handwriting Performance	X^2
Four	Girls	18.2%	65.2%	
	Boys	81.8%	34.8%	6.83*
Five	Girls	27.3%	62.5%	
	Boys	72.7%	37.5%	3.92*
Six	Girls	40.0%	70.4%	
	Boys	60.0%	29.6%	2.9

Each question on the H.P.R.C. had four possible responses. The responses described the handwriting item to varying degrees of quality. For most of the questions the two responses falling to the left half of the page reflected poor handwriting performance. The responses falling to the right half of the page reflected good handwriting performance. The exception to this was in questions one and two where the third item described the most desirable characteristic of the handwriting item.

The following results describe the nature of the specific difficulties identified by teachers for the ten questions of the checklist. Examination of the response patterns by grade for the group with handwriting difficulty (N=32) is compared to those for the other subjects (N=74). Differences in response patterns by gender were not found therefore the following analysis includes both males and females combined.

Table 3 presents the results for question number one which addresses the pressure the child exerts on the paper when writing. Results for all grades combined indicate a clear difference in the response pattern for "suitable pressure" with 83.0% of the "not" concerned group using suitable pressure and only 44.0% of the "concern" group. There is a tendency towards excessive pressure for the "concern" group (31.0%) though a small percentage of the concern group (16.0%) use inadequate pressure. Across the grades, there exists some anomalies and no clear developmental trend.

Table 3

Teacher Responses Indicating Pressure Exerted on the Paper When Writing for Both Groups

	Very Excessive Pressure		Excessive Pressure		Suitable Pressure		Inadequate Pressure	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	0.0%	0.0%	36.4%	17.4%	54.5%	82.6%	9.1%	0.0%
Grade 5	27.3%	0.0%	27.3%	12.5%	36.4%	87.5%	9.1%	0.0%
Grade 6	0.0%	0.0%	30.0%	18.5%	40.0%	77.8%	30.0%	3.7%
All Grades	9.4%	0.0%	31.3%	16.2%	43.7%	82.4%	15.6%	1.4%

Note: Table 1 includes total number of subjects for each grade.

Table 4 presents the results for question number two which is concerned with body tension when writing. The majority of the responses for all grades combined in the "concern" and "not" concerned group indicate "little tension" in the handwriting performance of the students.

Table 4

Teacher Responses Indicating Body Tension When Writing for Both Groups

	Very Tense		Tense		Little Tension		No Tension	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	0.0%	0.0%	0.0%	17.4%	72.7%	39.1%	27.3%	43.5%
Grade 5	18.2%	0.0%	36.4%	20.8%	36.4%	54.2%	9.1%	25.0%
Grade 6	10.0%	0.0%	20.0%	14.8%	60.0%	70.4%	10.0%	14.8%
All Grades	9.4%	0.0%	18.8%	17.6%	56.3%	55.4%	15.6%	27.0%

Table 5 presents results for question number three which addresses pencil grip. A very efficient grip would be characterized by a dynamic tripod grip with relaxed hand, arm and shoulder movements. Through observation of the students at work, the rater was instructed to judge the efficiency of the grip. The results indicate a clear pattern of responses for the "not" concern and the "concerned" group. For all grades combined, a large majority of the "not" concern group were judged to have an "efficient" or a "very efficient" grip (91.9%). In the

"concerned" group, 46.8% where judged as displaying an "efficient" grip. Also, the pattern of responses for the descriptors "very inefficient" and "efficient" revealed a deterioration in the efficiency of the handwriting grip with an increase in grade level. In addition, 72.7% of the grade four students were identified as having an efficient grip as compared to 27.3% and 30.0% in grades five and six respectively. This may be due to more time spent in handwriting instruction and the opportunity to practice letter formation in the grade four curriculum. Another possible explanation may be that grade four teachers accept a less efficient but developmentally appropriate grip for grade four students.

Table 5

Teacher Responses Indicating Handwriting Grip for Both Groups

	Very Inefficient		Inefficient		Efficient		Very Efficient	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	9.1%	0.0%	18.2%	4.3%	72.7%	91.3%	0.0%	4.3%
Grade 5	18.2%	0.0%	45.5%	20.8%	27.3%	66.7%	9.1%	16.7%
Grade 6	20.0%	0.0%	50.0%	3.7%	30.0%	96.3%	0.0%	0.0%
All Grades	15.6%	0.0%	37.5%	9.4%	43.7%	85.1%	3.1%	6.8%

Table 6 presents results for question number four which addresses the legibility of the finished product. The results for all grades combined indicate a clear pattern of responses for the "concerned"and the "not" concern groups. In the "not" concern group 91.9% of the

responses represent a "very legible" or "excellent" handwritten product. In the "concern" group, the majority of responses (65.6%) were judged to be "not very legible". As well, when taking into account the responses that describe an "illegible" performance for the "concern" group the number increases to 75.0% of the responses across the grades. Of the "concern" group, 25.0% of the responses were judged to display "very legible" handwriting.

Table 6

Teacher Responses Indicating Handwriting Legibility for Both Groups

	Illegible		Not Very Legible		Very Legible		Excellent	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	18.2%	0.0%	63.6%	0.0%	18.2%	91.3%	0.0%	8.7%
Grade 5	0.0%	0.0%	81.8%	16.7%	18.2%	62.5%	0.0%	16.7%
Grade 6	10.0%	0.0%	50.0%	3.7%	40.0%	92.6%	0.0%	3.7%
All Grades	9.4%	0.0%	65.6%	6.8%	25.0%	82.4%	0.0%	9.5%

Table 7 presents results for question number five which is concerned with the correct formation of the letters. This would include such things as letter reversals and reproductions of letters from charts or chalkboards. For all grades combined, and particularly in grades four and five, teachers rated correct letter formation as an indicator for concern. There clearly was a different response pattern in the "concern" and "not" concerned group. In the "concern" group, 87.5% of the

responses indicate "some difficulty" or "great difficulty" and only 23% of the "not" concerned experienced difficulty in these areas.

Table 7

Teacher Responses Concerning Letter Formation for Both Groups

	Great Difficulty		Some Difficulty		Little Difficulty		No Difficulty	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	27.3%	0.0%	63.6%	17.4%	0.0%	52.2%	9.1%	30.4%
Grade 5	36.4%	0.0%	54.5%	25.0%	0.0%	45.8%	9.1%	29.2%
Grade 6	10.0%	0.0%	70.0%	25.9%	20.0%	70.4%	0.0%	3.7%
All Grades	25.0%	0.0%	62.5%	23.0%	6.3%	56.8%	6.3%	20.3%

Table 8 presents results for question number six which addresses the student's ability to keep within the lines. For all grades combined, the data indicates that the majority of students (93.3%) in the "not" concerned group were able to keep within the lines "often" or "nearly always". In the "concerned" group 59.4% of the students were able to keep within the lines when writing.

Table 8

Teacher Responses Indicating Students' Ability to Keep Within the Lines for Both Groups

	Rarely		Sometimes		Often		Nearly Always	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	9.0%	0.0%	36.4%	8.7%	36.4%	34.8%	18.2%	60.9%
Grade 5	9.1%	0.0%	18.2%	0.0%	36.4%	45.8%	36.4%	54.2%
Grade 6	10.0%	0.0%	40.0%	14.8%	20.0%	37.0%	30.0%	48.2%
All Grades	9.3%	0.0%	31.3%	8.1%	31.3%	39.2%	28.1%	54.1%

Table 9 presents results for question number seven which addresses the spacing of letters within words and words within a sentence. The results for all grades combined indicate that the majority of the students in the "not" concerned group experienced "little" or "no difficulty" in this area (87.8%). Of the "concern" group, 50.0% of the students experienced "little difficulty" and 40.7% "some difficulty".

Table 9

Teacher Responses Indicating Difficulty in Spacing of Words

	Great Difficulty		Some Difficulty		Little Difficulty		No Difficulty	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	0.0%	0.0%	36.4%	13.0%	45.5%	52.2%	18.2%	34.8%
Grade 5	9.1%	0.0%	45.5%	12.5%	27.3%	37.5%	18.2%	50.0%
Grade 6	10.0%	0.0%	40.0%	11.1%	40.0%	59.3%	0.0%	29.6%
All Grades	6.3%	0.0%	40.7%	12.1%	37.6%	50.0%	12.6%	37.8%

Table 10 presents results for question number eight which addresses inconsistencies in the slant of letters within words. The majority of students (68.8%) in the "concerned" group were inconsistent in the slant of letters within words "often" or "sometimes" and 18.8% of them "nearly always" experienced difficulty in this area. The majority of all students (89.2%) in the in the "not" concerned group experienced difficulties in this area "sometimes" or "rarely".

Table 10

Teacher Responses Indicating Inconsistency in the Slant of Letters Within Words for Both Groups.

	Nearly Always		Often		Sometimes		Rarely	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	18.2%	0.0%	36.4%	4.3%	45.4%	65.2%	0.0%	30.4%
Grade 5	36.4%	0.0%	27.3%	16.7%	27.3%	50.0%	9.1%	29.2%
Grade 6	0.0%	0.0%	30.0%	7.4%	40.0%	74.1%	30.0%	18.5%
All Grades	18.8%	0.0%	31.3%	9.5%	37.5%	63.5%	12.5%	25.7%

Table 11 presents results for question number nine which addresses the child's ability to "keep up" with his or her classmates in exercises that involve copying from the chalkboard or chart. The results present a fairly equal distribution (approximately 50%) of responses describing both desirable and undesirable characteristics of this item. In examining the results grade by grade it would appear that this item is a good indicator of concern in grades four and five. For the "concern"

group, 54.6% of the grade four students, 44.5% of grade five students and 40.0% of grade six students "nearly always" or "often" experienced difficulty in this area. This may be due to the greater emphasis placed on working from the board in the lower elementary grades.

The responses in the "not" concerned group indicate that the majority of students (89.2%) "sometime" or "rarely" experience difficulty in "keeping up" to their peers.

Table 11

Teacher Responses Indicating Child's Ability to "Keep Up" With Classmates in Copying Exercises for Both Groups.

	Nearly Always		Often		Sometimes		Rarely	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	36.4%	0.0%	18.2%	21.7%	18.2%	17.4%	27.2%	60.9%
Grade 5	36.4%	4.2%	9.1%	0.0%	45.5%	41.7%	9.1%	54.2%
Grade 6	20.0%	0.0%	20.0%	7.4%	40.0%	48.2%	20.0%	44.4%
All Grades	31.3%	1.4%	15.6%	9.4%	34.4%	36.5%	18.7%	52.7%

Table 12 presents results for question number ten which addresses the child's ability to complete written assignments. In both the "concern" and the "not" concerned group the responses indicate that the majority of children "often" or "nearly always" complete written assignments. The ability to complete written assignments does not appear to be a key indicator for concern for handwriting skill. It is interesting to note that for the "concern" group 72.2% of grade four,

54.6% of grade five and 60% of grade six students "often" or "nearly always" finished written assignments.

Table 12

Teacher Responses Indicating Frequency of Completing Written Assignments for Both Groups.

	Rarely		Sometimes		Often		Nearly Always	
	Concern	Not	Concern	Not	Concern	Not	Concern	Not
Grade 4	27.3%	0.0%	0.0%	8.7%	27.3%	39.1%	45.4%	52.5%
Grade 5	0.0%	0.0%	45.5%	0.0%	18.2%	33.3%	36.4%	66.7%
Grade 6	10.0%	0.0%	30.0%	7.4%	40.0%	22.2%	20.0%	70.4%
All Grades	12.5%	0.0%	25.0%	5.4%	28.1%	31.1%	34.4%	63.6%

In summary, the grade four results indicate that the majority of students display good fundamental or basic skills. For example, in the "concern" group 54.5% of the children apply suitable pressure when writing (Table 3), 72.2% display little body tension when writing (Table 4), 72.7% display an efficient pencil grip (Table 5) and 63.7% experience little or no difficulty in the spacing of words (Table 9). In grades five and six there is a tendency for greater dispersement of responses across the four descriptors. This may be due to regular instruction and the opportunity to practice in grade four. As well, during these early attempts at handwriting negative experiences have not taken their toll and students may approach the task in a more positive and enthusiastic way.

Part Two

Part two of this study was to establish the reliability of the Handwriting Performance Rating Checklist. The results provide the interobserver agreement in percentages for the question regarding teacher concern for handwriting performance followed by agreement rates for the ten questions of the H.P.R.C.

Question two examines the interobserver reliability of the H.P.R.C. The procedure for establishing interobserver reliability involves having different teachers rate the same students and analyzing the results. Grade seven teachers were selected for the task because grade seven students rotate to different teachers for all subjects and having two teachers familiar with the same student's handwriting skills is essential. Four grade seven teachers from each of the four involved schools were asked to rate four previously selected students. Using one sample of the students handwriting they were asked to answer questions four, five, six, seven and eight of the H.P.R.C. Through observation and from past experiences with the student they were asked to answer questions number one, two, three, nine and ten. The teachers were then asked to pass the checklist and the sample of the student's handwriting to another teacher familiar with the student's handwriting skills and behavior. The second teacher received instructions on the completion of the checklist from the contact teacher and completed the rating independent of the contact teacher.

The following information was gathered from the results. Four of the 16 pairs of teachers agreed they were concerned with the handwriting skills of the child, ten pairs of teachers agreed they were "not" concerned and two pairs disagreed on the other's evaluation. The

interobserver agreement score for the initial question of concern or lack of concern for student handwriting performance was 87.5% agreement.

In the majority of cases, teacher A and teacher B appeared to be very consistent in their evaluation of the handwriting performance. The teacher's responses in terms of exact agreement, disagreement and agreement on similar evaluation characteristics for the ten question of the H.P.R.C. are in Table 13.

Table 13

Teacher Agreement or Disagreement in the Rating of Subject's Handwriting Performance

Note: The percentages are derived from the number of questions in agreement or disagreement.

	All Subjects
Exact Agreement	122
Disagreement	37
Percent Agreement	76.7%
Agreement including same and similar evaluation characteristics (not including Question #1)	132
Disagreement	12
Percent Agreement	91.7%

The overall percentage of interobserver agreement was calculated by using each question for each subject. This yielded 160 data points for comparison of teachers scores. The agreement was 76.7% for all teachers and students combined. In a less conservative analysis where similar characteristics such as "little difficulty" and "no difficulty" were accepted as "agreements" the interobserver agreement reached 91.7%. In other words, the teachers are largely in agreement when they identify a child as having inappropriate characteristics in their handwriting.

There were exceptions to the pattern of ratings given to subjects one, six and twelve with inter-observer agreement scores of 40%, 30% and 50% (see Appendix E). A possible explanation for these peculiarities may be found in the procedure utilized by one of the teachers. In two of the three cases of exception the same teacher was involved. As well, in the third case where an exception was found the teacher seemed preoccupied and uninterested in the project. In conclusion, one cannot be absolutely certain that the teachers did adhere to the correct protocol for the task, though most teachers indicated at a later date that they based their responses on the handwriting sample provided and their impression of the child's work habits.

Part Three

Part three of this study examines the stability of handwriting performance from one year to the next year. The results provide the percentage of interobserver agreement on the H.P.R.C. for teachers responding to the question of concern for handwriting performance as well as for the ten items of the H.P.R.C.

Question three examines the stability of handwriting performance over two years. A follow up of 16 subjects from the initial distribution were studied one year later. The subjects were in grade six in 1988 and in grade seven in 1989. The teachers received the same instructions for completing the H.P.R.C. Of the 16 pairs of teachers, one responding to the student's handwriting performance in 1988 and the other the student's handwriting performance in 1989, 14 pairs of teachers gave the same evaluation of the student's handwriting performance from one year to the next. Nine pairs were not concerned with the handwriting performance of the student, five were concerned, one set of responses was spoiled and in one set a teacher disagreed on the other's evaluation of the student's handwriting performance, with the concern being expressed by the grade six teacher. The interobserver agreement score for the initial question of concern or lack of concern from teacher to teacher was 87.5% agreement. The teacher's responses in terms of exact agreement, disagreement and same and similar evaluation characteristics for the ten questions of the H.P.R.C. are in Table 14 (see Appendix F for raw data).

Previous results suggest reliability of the H.P.R.C. therefore, the similarities in the evaluations from one year to the next may indicate that handwriting performance is a stable characteristic of the student. Likewise, a change in the evaluation from one year to the next would seem to indicate a change in the handwriting performance of the student.

Table 14

Teacher Agreement or Disagreement in the Rating of Subject's Handwriting Performance Over Two Years.

	All Subjects
Exact Agreement	112
Disagreement	48
Percent Agreement	70.0%
Agreement including same and similar evaluation characteristics (not including Question #1)	118
Disagreement	26
Percent Agreement	81.9%

Part Four

Part four of this study investigated the incidence of handwriting difficulties in physically awkward subjects. The results provide percentages of teacher responses to concerns for handwriting performance. A statistical analysis to compare the physically awkward group to the non awkward population was conducted. The percentages of responses for each item of the H.P.R.C. conclude this section.

In question four the purpose was to establish the incidence of handwriting difficulties in physically awkward subjects. The criteria for selection of subjects was through observed physical difficulties in performing movement requirements during the physical education class. Children identified as experiencing difficulty in the performance of movement requirements during class were given a more in-depth test of

motor proficiency designed to assess performance of the basic movement skills (see Appendix D).

Twenty nine children were confirmed as physically awkward. In the physically awkward group 16 of the responses (55.2%) indicated a concern for handwriting skills. Of the 16 subjects, 11 (69.7%) were male and five (31.3%) were female. The thirteen remaining subjects were in the "no concern" group with seven being male and six being female. The greatest concern for handwriting performance was in grade four followed by grade five and grade six.

The incidence of handwriting difficulties in a group (N=106) of grade 4, 5 and 6 children was identified in part one of the study. These children had not been screened for fine or gross motor difficulties prior to their involvement in the study. The results for the incidence of handwriting difficulties in the two groups (physically awkward and randomly selected) have been summarized in Table 15.

The information indicates that more children in the physically awkward group were judged by their teachers as having handwriting difficulties or concerns (55.2%) than those in the randomly selected group (30.2%). There were twice as many males as females identified as having handwriting difficulties in both the physically awkward and randomly selected groups.

Table 15

Incidence of Handwriting Difficulties in a Physically Awkward and Randomly Selected Group of Children

		Physically Awkward (N=29)	Randomly Selected (N=106)
Concern	Total	16 (55.2%)	32 (29.9%)
	Male	11 (68.7%)	23 (71.9%)
	Female	5 (31.3%)	9 (28.1%)
Not Concerned	Total	13 (45.0%)	75 (70.1%)
	Male	7 (53.8%)	26 (34.7%)
	Female	6 (46.2%)	49 (65.3%)

Table 16 indicates the percentages of responses for the ten items of the H.P.R.C. for the physically awkward students in the "concern" group (N=16).

From this information a profile of an individual experiencing gross motor and handwriting difficulties may be identified. The majority of these students exhibited adequate pressure on the paper and an efficient handwriting grip (question 1 & 2). These items do not appear to contribute to a concern for handwriting performance. In 85.7 % of the cases some illegibility was evident (question 4). In 14.3% or two of the cases, the student was evaluated as displaying very legible handwriting. For all subjects but one, difficulty forming letters (question 5) and reproducing them was an indicator of concern.

Table 16

Percentage of Responses for the Handwriting Items in the "Concerned" Physically Awkward Group (N=16)

Question:	*Rating:*			
Pressure	Very Excessive 6.3%	Excessive 18.8%	Suitable 63.0%	Inadequate 12.5%
Tension	Very 0.0%	Tense 50.0%	Little 44.0%	No 6.3%
Grip	Very Inefficient 12.5%	Inefficient 18.8%	Efficient 68.8%	Very Efficient 0.0%
Legibility	Illegible 0.0%	Not Very Legible 87.5%	Legible 12.5%	Excellent 0.0%
Letter Formation	Great Difficulty 25.0%	Some Difficulty 68.8%	Little Difficulty 6.3%	No Difficulty 0.0%
Letter Alignment	Rarely 6.3%	Sometimes 56.3%	Often 31.3%	Nearly Always 6.3%
Spacing	Great Difficulty 25.0%	Some Difficulty 44.0%	Little Difficulty 31.3%	No Difficulty 0.0%
Inconsistency in Slant of Letters	Nearly Always 6.3%	Often 56.3%	Sometimes 31.3%	Rarely 6.3%
Falling Behind	Nearly Always 57.1%	Often 31.3%	Sometimes 12.5%	Rarely 0.0%
Completes written assignments	Rarely 12.5%	Sometimes 50.0%	Often 25.0%	Nearly Always 12.5%

The remaining questions address the child's ability to keep within the lines (question 6), the spacing of letters within words and within sentences (question 7) and the slant of letters within words (question 8). Results indicate that in approximately 64.0% of the responses these items were indicators for concern.

In 85.7% of the cases the child's ability to "keep up" ("nearly always" or "often") with classmates in exercises that involve copying from the board (question 9) was an indicator for concern. As well, in 64.3% of the cases the child's ability to complete ("rarely" or "sometimes") handwritten assignments (question 10) was an indicator of concern.

These results are quite different from the previous results presented examining the incidence of handwriting difficulties in a group of students not screened for physical awkwardness. The subjects profile in the random sample where a concern for handwriting performance existed pointed to illegible handwriting performance, poor letter formation and inconsistency in the slant of letters within words and words within sentences. These items are also part of the profile for the physically awkward group. However, the high percentage of subjects experiencing difficulty in "keeping up" and in completing assignments is an indicator of concern specific to the physically awkward group.

Another item of much disparity between the physically awkward subjects and the randomly selected subjects was in the forming and reproducing of letters (question number five) where 91.5% of the physically awkward group was identified as having difficulty. Again this would indicate that the physically awkward group experienced more problems in their handwriting performance.

A profile for the "no concern" responses for all grades consistently described more desirable characteristics of the handwriting items (see Appendix G). The results would indicate that physically awkward students experience more handwriting difficulties than their non awkward counterparts. The majority of physically awkward subjects experienced difficulty in all areas of handwriting with the exception of writing pressure and pencil grip.

CHAPTER FIVE

DISCUSSION

There were four primary questions investigated in the study. The purpose of part one of the study was to identify the incidence of handwriting difficulties in a population of grades four, five and six students and to examine the relationship of subject gender and grade level to handwriting difficulties. Part two examined the reliability of the H.P.R.C. Part three investigated the persistence of handwriting problems from one year to the next. Part four of this study examined the incidence of handwriting difficulties in physically awkward subjects and compared the results to a sample of non awkward children.

In part one, the results indicated that the incidence of handwriting difficulties is approximately 30% for the sample of grades 4, 5 and 6 children. In a class of thirty children, approximately ten may have handwriting difficulties as identified through the H.P.R.C. serious enough to cause concern to the classroom teacher. This information is important in light of the implications of illegible handwriting in grades 4, 5 and 6. Children with handwriting that is difficult to read tend to receive lower grades regardless of content and frequent failure may lead to a negative self-concept (Briggs, 1970, 1980; Groff, 1984).

A significant proportion of male students comprised the group in which teachers indicated a "concern" for the handwriting skills of the student. This was found for a sample of randomly selected children as well as a sample of physically awkward children. Much available

research would support a higher incidence of males within a physically awkward group of children (Zivani & Elkins, 1984; Silva, Birkbeck, Russell & Wilson, 1987; Gordon & McKinlay, 1980). Possible explanations for this may be inherent in genetic differences between gender that may provide an advantage of certain motor skills such as handwriting for one gender over the other. A study by Saida and Miyashita (1979) states that the majority of boys are capable of performing the small highly coordinated movements of the fingers required for correct pencil manipulation at four years of age where girls are proficient in this skill earlier, at three and one half years of age. If the idea that an improved gross and fine motor performance are built on earlier motor development as reported by Silva, Birbeck, Russell & Wilson (1987) it can be expected that females will generally display superior handwriting skills.

According to the Knowledge Based Approach, the findings of this study may suggest that development of the knowledge bases specific to handwriting may occur at an earlier age in females. It may be expected that the high ratio of males to females experiencing handwriting difficulties would decrease as the male knowledge base development specific to handwriting proceeds. Alternatively, the nurturing of traditional gender socialization roles for groups of girls as opposed to groups of boys may explain the differences in handwriting. Within traditional western culture, girls are taught to be neat and are discouraged from rough and tough activity. They are more likely to spend more time and effort involved in quiet manipulative activity than are boys. The effects of procedural practice in fine motor activities such as coloring, cutting and drawing may lend themselves to the transference of concepts within a

related domain. Consequently a rich procedural and declarative knowledge base in manipulative skills may result in handwriting aptitude. As well, affective knowledge in these tasks may be more readily developed in females through the fulfillment of stereotype roles and expectations. In a study by Zivani & Elkins (1984) girls were found to produce significantly fewer mistakes than boys in letter formation, an important characteristic of legible script. Furthermore, girls were found to write significantly faster than boys. These findings may be attributed to expected social roles resulting in the opportunity for more frequent practice for girls.

A grade level difference in teachers responses across the grades was not found for this study through a Chi Square analysis ($X^2 = (2, N = 106) = .279$). Possible explanations may be that the incidence of handwriting difficulties across the grades remained similar, or teachers responded according to the H.P.R.C. and not their expectations from past experiences of handwriting at that grade level.

An analysis of the teacher responses for the Handwriting Performance Rating Checklist revealed some concern for the validity of some items. Of the ten items used in the checklist the concerns are as follows. For question one, there was a clear indication that the descriptor "very excessive pressure" was not necessary and in the case of the grade five "concern" group may have lead to some confusion in the selection of the appropriate descriptor. The descriptor "inadequate pressure" may have jeopardized the internal consistency of the descriptors for this item since both "inadequate pressure" and "excessive pressure" can be a cause for teacher's concern. For question two the descriptor "no tension" may have been confusing to teachers as it could

have been perceived as both a desirable and an undesirable characteristic of handwriting. Therefore, this item may have generated unreliable results. Teachers commented on the need to include the descriptor "legible" in the checklist for question three. As well, the descriptor "excellent" may not have been appropriate since the task was to identify the handwriting characteristics of the "concerned" group. For several of the items, the use of a four point scale to describe varying degree of a handwriting quality was inappropriate. For example, "no tension" to describe body tension when writing or "very efficient" to improve upon "efficient" in describing pencil grip. It is recommended that a three point scale rather than a four point scale be used to avoid confusion in selecting a descriptor and to maintain internal consistency. The last two questions addressing the child's ability to "keep up" and complete assignments may not be necessary to the checklist as they present many uncontrolled variables such as visual problems, visual perceptual problems, fatigue and lack of motivation. As well, a weakness in these areas may reflect other factors such as increased difficulty in assignments and a lack of motivation to complete assignments.

Prior to addressing the ten questions of the checklist, the teacher's overall impression of the child's handwriting performance was established. The teacher indicated either "yes" I am concerned about the handwriting skills of this child or "no" I am not. The placement of this question at the beginning of the checklist caused some teachers to ignore the completion of the checklist. A summative question of this nature would be better placed at the end of the checklist. This would allow teachers to formulate a more accurate rating based on the information derived from the checklist items.

Subjects identified as having handwriting difficulties were almost always rated as having illegible handwriting, poor letter formation and observable body tension. Subjects of the "not" concern for handwriting difficulties group were described as exhibiting an efficient grip (body posture), very legible handwriting and suitable pressure on the paper when writing. Legible handwriting for both groups appears to be a discriminating factor in evaluating handwriting. Perhaps legibility in handwriting serves as an umbrella that encompasses the other parameters or handwriting such as letter formation, spacing, slant, alignment and size.

Eighty percent of the students in the "not" concerned group were given similar or same side evaluations of their handwriting performance for nine of the ten questions (the exception was in question number five). In the "concern" group, the results for all grades indicate a greater dispersement of results across the four descriptors of the question. Questions number four and five are two questions where a clustering of responses occurs. In question number four regarding writing legibility, 76% of the students in the "concerned" group were identified as having "illegible" or "not very legible" handwriting. In question number five regarding letter formation, 87% of the students were identified as experiencing "great difficulty" or "some difficulty". This may indicate that the H.P.R.C. is a fairly good screening instrument of handwriting performance as it does identify characteristics of handwriting difficulty. However, it does not effectively isolate the causes concerning children experiencing handwriting difficulties.

In summary, a student profile characterizing a concern for handwriting performance includes illegible handwriting, poor letter

formation and inconsistency in the slant of letters within words and words within sentences. A student profile characterizing a lack of concern for handwriting performance consistently described more desirable characteristics of the handwriting items. These students were generally given high ratings in body posture, handwriting grip, legibility, letter formation, ability to "keep up" and complete handwritten assignments. In terms of the Knowledge Based Approach, these findings suggest that the students in the "concern" group may have a poorly developed procedural knowledge base in the fine motor domain and specifically in handwriting skills. This is displayed in their inability to form the letters as required for legible handwriting. As well, they may be lagging in their development of declarative knowledge (ability to recall letters from memory), affective knowledge (motivation to learn to write) and metacognitive knowledge and skills.

The reliability of the H.P.R.C. was examined in part two of the study. To test the H.P.R.C. for interobserver reliability, sixteen grade seven subjects were rated by two of their classroom teachers. The interobserver reliability scores for the initial question of concern or lack of concern for handwriting performance was 87.5% agreement. The overall percentage of interobserver agreement was calculated by using each question of the H.P.R.C. in agreement for each subject. This yielded 160 data points for comparison of teacher responses. The scores were 76.3% in agreement. In other words, teachers can use the H.P.R.C.with a high degree of reliability that their results will be fairly consistent. It is important to note that establishing reliability at the grade seven level does not indicate reliability at the grade four and five level.

Part three investigated the persistence of handwriting problems from one year to the next. Sixteen students where rated by their grade six teacher and again sixteen months later by their grade seven teacher. The assumption is that agreement from the grade six teacher to the grade seven teacher will confirm the handwriting item as a stable characteristic of the student's handwriting performance. On the other hand, disagreement will present the possibility of a change in the handwriting performance of the child or lack of reliability in the instrument. Of the 16 pairs of teachers in this study, a high agreement rate (87.5%) on the initial question suggests good agreement on the overall evaluation of the writing performance from teacher to teacher and from one year to the next year. This may indicate that handwriting performance is a stable characteristic of the student from one year to the next.

It is interesting to note that the students in grade seven were evaluated by their teachers as displaying more desirable characteristics of the handwriting items as described in the H.P.R.C. This contradicts a study by Ziviani & Elkins (1984) where letter formation improved gradually up to grade six and then deteriorated. It is possible that a decreased emphasis is placed on teaching handwriting by the grade six teachers. Grade six teachers may place a greater emphasis on the social and academic skills required for graduation to junior high school. In other words the priorities of classroom activities shifts in succeeding years and the message, content and product is stressed rather than the medium or the demonstrated handwriting skills. The grade seven teachers may be responding to their perceptions of the handwriting legibility of the average grade seven student. In fact, grade seven teachers may become desensitized to what constitutes legible

handwriting and therefore be inaccurate in their evaluation of handwriting performance. Herrick and Okada (1963) state that improvement in handwriting skill plateaus rapidly from the third grade on. This may suggest that by grade four or five the procedural aspects of handwriting may be more or less automatized for the majority of children therefore, teachers are no longer concerned about trying to teach or change the skills.

Much of the available literature describes difficulty with manipulative skills as a characteristic associated with physical awkwardness. Part four of this study examined the incidence of handwriting difficulties in physically awkward subjects and investigated the extent to which awkwardness in fine motor skills accompanies awkwardness in gross motor skills.

Twenty nine children were confirmed as physically awkward in grades 4, 5 and 6. Slightly more than half (55.2%) of the physically awkward subjects were also identified as having handwriting difficulties. In terms of the Knowledge Based Approach the motor awkwardness across domains may be due to inadequately generalizable knowledge bases preventing the transference of concepts, poorly developed knowledge bases, limits in structural capacity, general practice deficits or the interaction of genetic and experiential factors. The incidence of concern for handwriting skills in physically awkward children is not high enough to suggest that gross motor awkwardness is a general characteristic that crosses into the fine motor domain. In 45% of the physically awkward children where handwriting is not a concern the presence of awkwardness may be attributable to specific practice deficits, specific limitations in genetic endowment or a combination of the two.

In the randomly selected elementary school sample used in this study, 30% were identified as having handwriting difficulties. The incidence of handwriting awkwardness in the physically awkward group of children was found to be significantly higher (55%) than in the randomly selected sample used in this study. These results may indicate that gross motor awkwardness may increase the risk of experiencing fine motor (handwriting) awkwardness.

Of the 16 physically awkward subjects identified as having handwriting concerns, 11 were male subjects (69%). It was very difficult to find female subjects that were physically awkward and in the upper elementary grades. The higher ratio of physically awkward boys to girls is supported in the literature (Gordon & McKinlay, 1980; Keogh et al., 1979).

The results indicate that physically awkward students experience more handwriting difficulties than a randomly selected group of their peers. The majority of physically awkward subjects experienced difficulty in all ten items of the H.P.R.C. with the exception of writing pressure and pencil grip. The randomly selected subjects experienced difficulty in letter formation, inconsistency in slant of letters and in legibility. The items of much disparity between the physically awkward subjects and the randomly selected subjects were in the areas of forming and reproducing letters, "keeping up" with classmates in copying exercises and in completing assignments. A high percentage of the physically awkward group were identified as having great difficulty in these areas. This may be due to a developmental lag in the declarative, procedural and metacognitive knowledge bases for these children.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

A purpose of this study was to determine the extent to which awkwardness in handwriting skill accompanies awkwardness in gross motor skill. A subsequent purpose was to examine the handwriting performance and the incidence of handwriting difficulties in boys and girls in grades four, five and six and to test the reliability of a handwriting screening checklist. Based on the results the following conclusions and recommendations are presented.

The incidence of illegible handwriting in grades four, five and six was found to be 30% of a given sample therefore, there is a need for teachers to provide procedural skills, opportunities to practice and to investigate structural deficits as reason for poor handwriting performance. The most serious implications for the student with illegible handwriting is a higher probability of lower school grades. Illegible written work often results in frustration in preparing written work. The affective knowledge base at this point may be impaired in developing a strong positive perception of competence. This alone may impact the student's present and future endeavors. It is recommended that all kindergarten children be screened for gross and fine motor difficulties and that follow up testing be conducted to determine the specific area of difficulty. A program of remediation based on the testing results should be administered on a near daily basis.

A second conclusion is that there is a lower incidence of handwriting difficulties in females. Females tend to display a more

legible script. It may be recommended that early practices and behaviors that lead to improved handwriting performance for females be adapted to male learning experiences and practices.

A third conclusion is that The Handwriting Performance Rating Checklist appears to be a reliable instrument to screen students for handwriting difficulties (include changes to checklist as indicated in Chapter 5). Teachers need to be given complete instructions for using the checklist. As well, samples describing and depicting each of the ten items of the checklist should be provided. Screening and follow-up testing using the "Diagnosis and Remediation of Handwriting Problems" by Stott et al. (1985) should be used to confirm any student suspected to be at risk. Standards of handwriting performance for children at different age levels and different stages of development is an area of study and research that does not seem to have been developed at this time. If such standards would be developed and made available to teachers, awareness of the sequential development of good handwriting skills and age related performance expectation may be incorporated.

A fourth conclusion is that physically awkward students experience more handwriting difficulties than a randomly selected group of elementary school age children. This may indicate a relationship between gross motor awkwardness and handwriting awkwardness. Therefore, it is recommended that educators be alert to possible difficulties in the manipulative ability of physically awkward children. As the results of this study do not provide conclusive evidence of this implication further research is warranted.

One further recommendation addresses the need for additional research to examine the involvement of metacognitive knowledge in

human performance. For example, is the child aware of what he or she can or cannot accomplish and how accurate is this information? What different problem solving strategies do skilled and unskilled performers utilize? Research may help to explain better methods of teaching. As Jarman stated "It is of no use to tell poor writers to improve their writing: they cannot do so because they do not know how to correct their faults and sometimes do not even know what is meant by good writing." (C. Jarman, 1979).

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Appendix A

HANDWRITING PERFORMANCE RATING CHECKLIST

CHILD'S NAME _____ AGE __ BIRTHDATE _____SEX __

SCHOOL _____TEACHER _____ GRADE __

PREFERRED WRITING HAND: RIGHT __ LEFT__ AMBIDEXTROUS ___

PLEASE ANSWER THE FOLLOWING QUESTION BEFORE COMPLETING THIS SCALE.

I am concerned about the handwriting skills of this child.

_____ YES _____ NO

Please complete the rest of this form by checking ( ) below the descriptor that best illustrates the child's performance. Please check only one descriptor for each question.

1) This child places excessive pressure on the paper when writing.

Very Excessive Pressure	Excessive Pressures	Suitable Pressure	Inadequate Pressure

2) To what degree does this child display excess body tension when writing.

Very Tense Tense	Tense	Little Tension	No Tension

3) When this child is writing his/her grip appears to be:

Very Inefficient Efficient	Inefficient	Efficient	Very

4) This child's writing is:

Illegible	Not Very Legible	Very Legible	Excellent

5) When forming letters this child has difficulty reproducing them correctly.

Great Difficulty	Some Difficulty	Little Difficulty	No Difficulty

6) When writing this child is able to keep within the lines.

Rarely Always	Sometimes	Often	Nearly

7) When writing a sentence, to what extent does this child experience difficulty in the spacing of words.

Great Difficulty	Some Difficulty	Little Difficulty	No Difficulty

8) How often does this child's writing appear to be inconsistent in the slant of letters within words.

Nearly Always	Often	Sometimes	Rarely

9) This child has difficulty "keeping up" with his/her classmates in exercises that involve copying from the board or chart.

Nearly Always	Often	Sometimes	Rarely

10) This child finishes written assignments:

Rarely	Sometimes	Often	Nearly Always

Appendix B(I)

Ms. Barbara J. Cerilli
Motor Skills Resource Teacher
River East School Division No. 9
589 Roch Street
Winnipeg, Manitoba
R2K 2P7
September 22, 1987

Dear Colleague:

I am writing to request your help in completing some research for my Master's thesis. Your Principal is aware of this project and has agreed to allow me to approach you for your help.

The research I am doing is directly related to my activities as a Motor Skills Resource Teacher in the River East School Division. Briefly, the study examines the incidence of handwriting difficulties in elementary school-age children who have been previously identified as having motor difficulties.

Phase one of the project, where I am seeking your assistance, is concerned with establishing group norms. These norms are established through the completion of the Fine Motor Rating Scale form, for a randomly selected group of grades 4, 5 and 6 students. I would have you complete this form for six of your students (three girls and three boys) who are randomly selected but who are all the same age. The attached pages provide you with the instructions for classifying and selecting this group and blank rating scale forms.

I am attempting to complete this phase of the project by the second week in October and therefore would request that you return six completed rating scale forms (in the enclosed envelope) at your earliest convenience, but prior to the my deadline.

Confidentiality for the subjects is assured and if you have any other concerns or questions you may call me at my home in Winnipeg telephone 253-5803.

Thank you very much for your co-operation in this matter. I realize how busy you are at this time of the year so your help is truly appreciated.

Sincerely

Barbara Cerilli

Appendix B(ii)

HANDWRITING RATING CHECKLIST INSTRUCTIONS

1. **Selection of Subjects**

For each grade an age category of subjects has been selected (child's age on day of rating). These are as follows:

GRADE 4 - nine years old
GRADE 5 - ten years old
GRADE 6 - eleven years old

Upon identifying all children in your "grade age category" a breakdown by male and female gender should be made. this would be a list of all boys in your "grade age category" and a list of all girls in your "grade age category." From this a random selection of six subjects may be made.

Selection should include an equal number of boys and girls (three of each) using a boy, girl, boy, girl, boy, girl, sequence.

Using the following 6-digit random number select the subjects from your lists of boys and girls.

YOUR RANDOM NUMBER:

Count down your list of boys the number of the first digit of your random number to identify your first male subject (if you reach the bottom of your list before you reach your number continue from the top again). Complete the top portion of the rating scale form for that student.

Count down your list of girls the number of the second digit of your random number to identify your first female subject (if you reach the bottom of your list, continue from the top again). Complete the top portion of the rating scale form for that student as well.

Continue the same procedure and alternating sequence for the remaining four subjects.

5. **Rating Scale Form Completion**

Please answer all of the questions for each child by accurately assessing the handwriting functions that he or she displays and then checking off the most appropriate description from those given.

Once again, thank you for your help in this matter.

Appendix C

Thank you very much for your help. I realize how busy you are at this time of year so this is truly appreciated.

Instructions for Completion of Checklist:

1. Using a sample of the students handwriting please answer questions #4, 5, 6, 7, and 8 on the Handwriting Performance Rating Checklist.

   Through observation and from past experiences with the student please answer questions 1, 2, 3, 9 and 10.

2. Pass the second Handwriting Performance Rating Checklist plus the handwriting sample to another teacher familiar with the students handwriting skills.

   Repeat step #1 for completion.

3. Please return the completed checklists to me in the envelope provided.

   Once again, thank you so much.

Sincerely,

Barb Cerilli

Appendix D

RIVER EAST SCHOOL DIVISION NO. 9
MOTOR SKILLS RESOURCE PROGRAM
BASIC MOTOR SKILLS CHECKLIST
SUMMARY FORM

* **FOR SCHOOL USE ONLY**

Name: _____ Sex: ___

School: _____

Date Tested _____
Yr/Mth/Day

Date of Birth _____
Yr/Mth/Day

Age _____

Assessment Recommendations

1. Does not require a M.S.R.P. ☐
2. Required a M.S.R.P. (check one)
   Indiv./Small Grp. ☐ Continue ☐
   Borderline/Monitor in P.E. Program ☐

Area of Emphasis:
Transport ☐
Manipulative ☐
Balance ☐

Arm Preference:

☐ Right ☐ Left ☐ Mixed

Leg Preference:

☐ Right ☐ Left ☐ Mixed

TEST SUMMARY

1. Transport Skills

   Run _____

   Gallop _____

   Jump _____

   Hop _____

   Skip

II. Manipulative Skills
Catch

Overhand Throw

Kick

III. Balance Static - Right

- Left

Dynamic - Forward

- Sideways

- Backward

Barb Cerilli
Motor Skills Resource Teacher

Appendix E

Raw Data for Interobserver Agreement Scores Between the Grade Seven Teachers.

Subject	1	2	3	4
Exact agreement	4	8	10	10
Exact Disagreement	5	1	0	0
Same side agreement	1	1	0	0
Interobserver agreement	40%	80%	100%	100%

Subject	5	6	7	8
Exact agreement	7	3	10	9
Exact Disagreement	0	5	0	0
Same side agreement	3	2	0	0
Interobserver agreement	70%	30%	100%	90%

Subject	9	10	11	12
Exact agreement	8	8	8	5
Exact Disagreement	0	0	0	0
Same side agreement	2	2	2	5
Interobserver agreement	80%	80%	80%	50%

Subject	13	14	15	16
Exact agreement	7	7	10	8
Exact Disagreement	0	0	0	0
Same side agreement	3	3	0	2
Interobserver agreement	70%	70%	100%	80%

Appendix F

Raw Data for Interobserver Agreement Scores Between the Grade Six and Grade Seven Teachers.

Subject	1	2	3	4
Exact agreement	6	4	7	8
Exact Disagreement	3	6	0	1
Same side agreement	1	0	3	1
Interobserver agreement	60%	40%	70%	80%

Subject	5	6	7	8
Exact agreement	9	6	7	4
Exact Disagreement	0	4	0	0
Same side agreement	1	0	3	6
Interobserver agreement	90%	60%	70%	40%

Subject	9	10	11	12
Exact agreement	8	8	10	4
Exact Disagreement	0	0	0	6
Same side agreement	2	2	0	0
Interobserver agreement	80%	80%	100%	40%

Subject	13	14	15	16
Exact agreement	10	4	9	8
Exact Disagreement	0	6	0	0
Same side agreement	0	0	1	2
Interobserver agreement	100%	40%	90%	80%

Appendix G

Distribution of Responses for the Physically Awkward Students in the Lack of Concern for Handwriting Performance Group.

1. This child places excessive pressure on the paper when writing?

Very Excessive Pressure	Excessive Pressure	Suitable Pressure	Inadequate Pressure
0%	28.6%	71.4%	0%

2. To what degree does this child display excess body tension when writing?

Very Tense	Tense	Little Tension	No Tension
0%	21.4%	57.2%	21.4%

3. When this child is writing his/her grip appears to be:

Very Inefficient	Inefficient	Efficient	Very Efficient
0%	14.3%	85.7%	0%

4. This child's writing is:

Illegible	Not Very Legible	Very Legible	Excellent
0%	7.1%	92.9%	0%

5. When forming letters this child has difficulty reproducing them correctly.

Great Difficulty	Some Difficulty	Little Difficulty	No Difficulty
0%	35.8%	14.3%	42.9%

6. When writing this child is able to keep within the lines.

Rarely	Sometimes	Often	Nearly Always
0%	0%	42.9%	57.2%

7. When writing a sentence, to what extent does this child experience difficulty in the spacing of words.

Great Difficulty	Some Difficulty	Little Difficulty	No Difficulty
0%	0%	50%	50%

8. How often does this child's writing appear to be inconsistent in the slant of letters within words.

Nearly Always	Often	Sometimes	Rarely
0%	28.6%	42.9%	28.6%

9. This child has difficulty "keeping up" with his/her classmates in exercises that involve copying from the board or chart.

Nearly Always	Often	Sometimes	Rarely
14.3%	7.1%	21.4%	64.3%

10. This child finishes written assignments:

Rarely	Sometimes	Often	Nearly Always
7.1%	21.4%	14.3%	57.2%